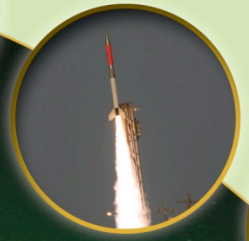
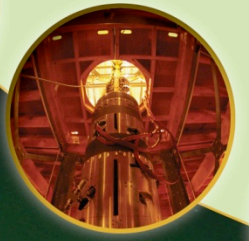
Sounding Rockets





Sounding Rocket Working Group

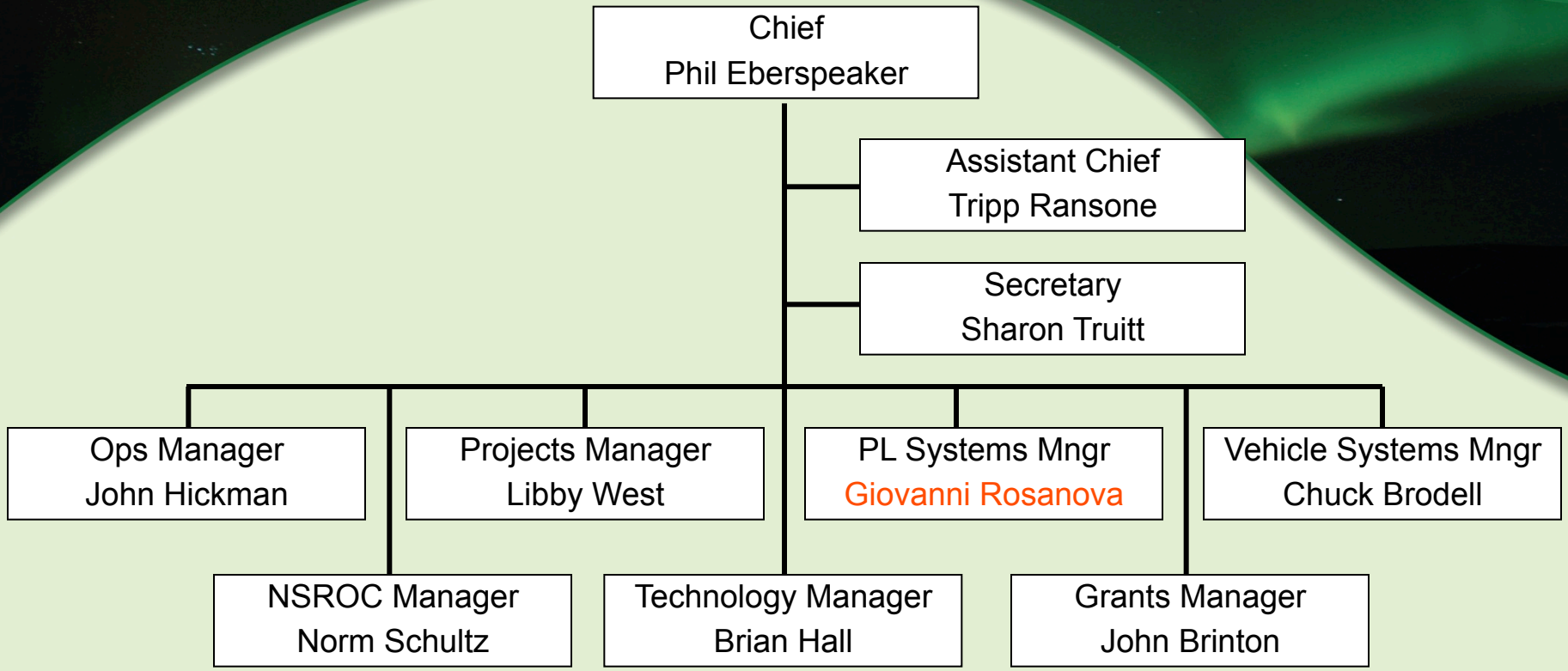
June 18, 2009

SRPO Briefing Outline

- Program Overview - Eberspeaker
  - SRPO Organization
  - Mission Results Summary (since last meeting)
  - FY09-FY11 Manifest
  - Mishap/Anomaly Investigation Status
- NSROC I and NSROC II Status - Ransone
- Poker Winter Campaign Status - West
- Launch Ranges - West
  - Poker Upgrade Concept
  - WSMR Consolidation
- Rocket Motor Status – Brodell
- Technology - Rosanova

- Findings from January SRWG Meeting

SRPO Staffing



Missions Flown Since Last SRWG

- Core
  - 21.139 & 36.242 / Bounds / ACES
    - Success
  - 41.076 – 41.079 / Lehmacher / Turbopause
    - Success
  - 40.023 / Lynch / CASCADES
    - Success
  - 36.226 / Bock / CIBER
    - Success
- Education
  - 30.073 / Thorsen / Student PL
    - Success
- Reimbursable
  - 41.080 / Murbach
    - Success
  - Terrier-Lynx (Airborne Laser Target)
    - Success

FY09 Schedule

#	Vehicle Type	FY 2009 Experimenter	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
		WALLOPS ISLAND												
1	Terrier Orion	Koehler/Univ. of Colorado									△			
2	Test Vehicle	Hickman/NASA-WFF										△		
3	Test Vehicle	Hickman/NASA-WFF										△		
4	Test Vehicle	Hall/NASA-WFF											△	
5	Test Vehicle	Hickman/NASA-WFF											△	
6	Test Vehicle	Hickman/NASA-WFF											△	
		WSMR												
7	Black Brant IX	Kowalski/NRL Success		▲										
8	Black Brant IX	Moses/NRL										△		
9	Black Brant IX	Bock/Cal Tech Success					▲							
10	Black Brant IX	Green/Univ. of Colorado									△			
11	Black Brant IX	Cash/Univ. of Colorado											△	
12	Black Brant IX	Davis/MSRF										△		
13	Terrier Orion	Erdman/Embry-Riddle University											△	
		PFRR												
14	Black Brant IX	Bounds/University of Iowa		Success		▲								
15	Black Brant VE	Bounds/University of Iowa		Success		▲								
16	Orion	Thorsen/University of Alaska		Success		▲								
17	Black Brant XII	Lynch/Dartmouth College						▲	Success					
18	Terrier Orion	Lehmacher/Clemson University					▲							
19	Terrier Orion	Lehmacher/Clemson University					▲							
20	Terrier Orion	Lehmacher/Clemson University					▲		Overall Success					
21	Terrier Orion	Lehmacher/Clemson University					▲							
		REIMBURSABLE MISSIONS												
22	Terrier Orion	Murbach/NASA-AMES						Success		▲				
23	Terrier-Lynx	MARTI/USAF-ABL							Success	▲				
24	Black Brant IX	MARTI/USAF-ABL									△			
25	Black Brant IX	MARTI/USAF-ABL									△			
26	Black Brant XI	Bernhardt/NRL												△
27	Black Brant IX	MARTI/USAF-ABL											△	
28	Black Brant IX	MARTI/USAF-ABL												△
29	Black Brant IX	Cheatwood/NASA-LARC										△		
30	Terrier Orion	Bull/Sub-TEC III/NASA-WFF										△		—

Current Planning Manifest

- FY10
  - 12 flights currently on the planning manifest
    - 8 WSMR
    - 3 Poker
    - 1 Norway
- FY11
  - 5 flights currently on the planning manifest

Failures and Anomalies

Failure	AIB lead	Status
NONE		

Anomalies	Lead	Status
- ACS Valve Issues (Kletzing & Bounds)	NSROC	Leaking valve attributed to combination of O-ring material, nozzle block design, long duration storage under pressure, and thermodynamic properties of Argon gas - Valve vendor has been visited and possible design changes have ben discussed - Review of general pneumatics configuration to be conducted

NSROC II

- Key Features
  - Full and Open Competition
  - Single Award
  - Five Year Period of Performance
    - No options
  - Indefinite-Delivery Indefinite-Quantity (IDIQ)
  - Cost-Plus-Incentive Fee (CPIF)
- Draft RFP has been released with minimal comments & questions
- Revised RFP under final review at Goddard
  - Has completed 1 of the 3 required internal reviews
- Will go to HQ for Legal review after approval by Goddard
- Current schedule calls for release of final RFP October 2, but could be sooner depending on how the final review progresses

NSROC I

- Current NSROC I contract expires June 30
- NASA plans to extend the current contract to June 30, 2010 due to delays in NSROC II contract development
- NASA HQ has provided approval for the Deviation required for this extension
- The synopsis to industry has been issued without comment
- Northrop Grumman's proposal is due June 18
- Plan is to have extension in place by July 1, but a short term Letter Contract Modification will be issued if necessary to prevent an interruption of service due to expiration of the contract

Poker Campaign Summary

- 2009 Missions
  - All flights/missions appear to have at least met minimum success.
  - 30.073 Thorsen
    - Nominal flight.
  - 36.242 & 21.139 Bounds
    - ACS valve anomaly on 21.139.
  - 41.076 – 41.079 Lehmacher
    - Nominal flights.
    - Launched into a nice event.
  - 40.023 Lynch
    - Restraint for PFF 2 fired early – causing PFF to eject with skirt deployment.

Poker Campaign Issues and Corrective Actions

- Fiber
  - Multi-mode fiber used over long distances. Always difficult getting clean data from Pad all the way up to TM.
  - Poker has started the process of migrating to single-mode fiber.
  - Set up meeting with NSROC and NENS to discuss plans for migration of fiber plant to single mode.
  - 2010 campaign – continue with multi-mode fiber
    - Request enough support from NENS to set up and troubleshoot.
    - The ability to play data over the lines (with a test tape) during setup will be beneficial
  - Migrate to Single mode during the transition to a control center at the SOC. First use 2012 campaign.

Poker Campaign Issues and Corrective Actions

- Poker Pathfinder Radar
  - Component failures and sensitivity adjustment issues at the beginning of the campaign.
  - NENS Radar tech and spare parts sent to field to support Pathfinder.
  - PFRR set up their P-Star mobile surveillance radar and contracted with AMES to provide the display.
  - P-Star radar certification and Pathfinder checkout flight scheduled.
  - Ran both systems for remainder of campaign with P-Star prime.
- P-Star for 2010 and beyond
  - WFF 2 P-Stars – SRPO to request RMMO to task NENS to develop a 2D display.
  - Backup - Poker P-star – PFRR to task UAF to develop a 2D display.

Poker Campaign Issues and Corrective Actions

- ACS Valve anomaly on 21.139 Bounds
  - Team of Code 500, NSROC, SRPO, and the vendor investigated the anomaly.
  - Poppet Seat O-ring identified as issue.
  - NSROC conducted extensive testing for valve performance after prolonged pressure load.
  - NSROC accounted for 29 valves to undergo rework at Preece.
  - NSROC Pneumatic Engineer and Engineering Director visited Preece to discuss valve performance.
  - Identified improvement to Poppet Seat – molded in place rather than a separate piece.
  - Evaluating options to reduce mean operating pressure of ACS.
  - NSROC developed and improved tracking of valve inventory to track pedigree and history of each asset.
  - Expecting the first of the new re-worked valves in early July – these will undergo in-house testing.

Poker Campaign Issues and Corrective Actions

- Potential Missed Launch Opportunities
  - A couple of instances of "new" launch constraints may have hampered our attempt to launch.
    - An agreement with a State Agency resulted in protecting the Chatanika river from 3 sigma booster impact dispersion.
  - SRPO and the WFF RSO worked with Poker during the Lynch mission to resolve the "new" booster impact launch constraint.
- Plans for 2010 and beyond
  - SRPO, Safety, and PFRR are in the process of developing a PFRR launch constraint list.
  - Mission specific launch constraint list will be developed for each individual mission.

Poker Upgrade Status

- Upgrades at Poker for 2009
  - SOC Boiler Upgrade
    - Energy efficiency/cost savings
  - PFRR Fiber Upgrade Completion
    - Complete installation of single mode fiber to all range sites
    - Coordination to switch from multi-mode to single mode needs coordination with NSROC
  - Blockhouse Repair
    - Leaky roof in ops room needs repair

Poker Upgrade Status

- Upgrades at Poker for 2009
  - Pad Fencing
    - Encompass pad area with fence
    - Security/Safety enhancement
  - Down Range Instrument Upgrade
    - Subcommittee Report issued
    - $75K allocated to upgrade/repair instruments
    - Feasibility of adding Toolik Lake as standard site
    - Will be added to Campaign Action list for 2010 and tracked by SRPO

Findings from July 2008 SRWG

PFRR Operations Move to SOC (Finding #3)

- Blockhouse is no longer suitable site for "Control Center"
  - Safety and overcrowding issues
- SOC identified as preferred site to create PFRR Consolidated Control Center
  - Would bring science and range personnel together
  - Eliminates safety issue and overcrowding
- Other sites not as ideal
  - Close to launch danger areas
  - Eliminate direct science interaction
  - New building is out of question

Findings from July 2008 SRWG

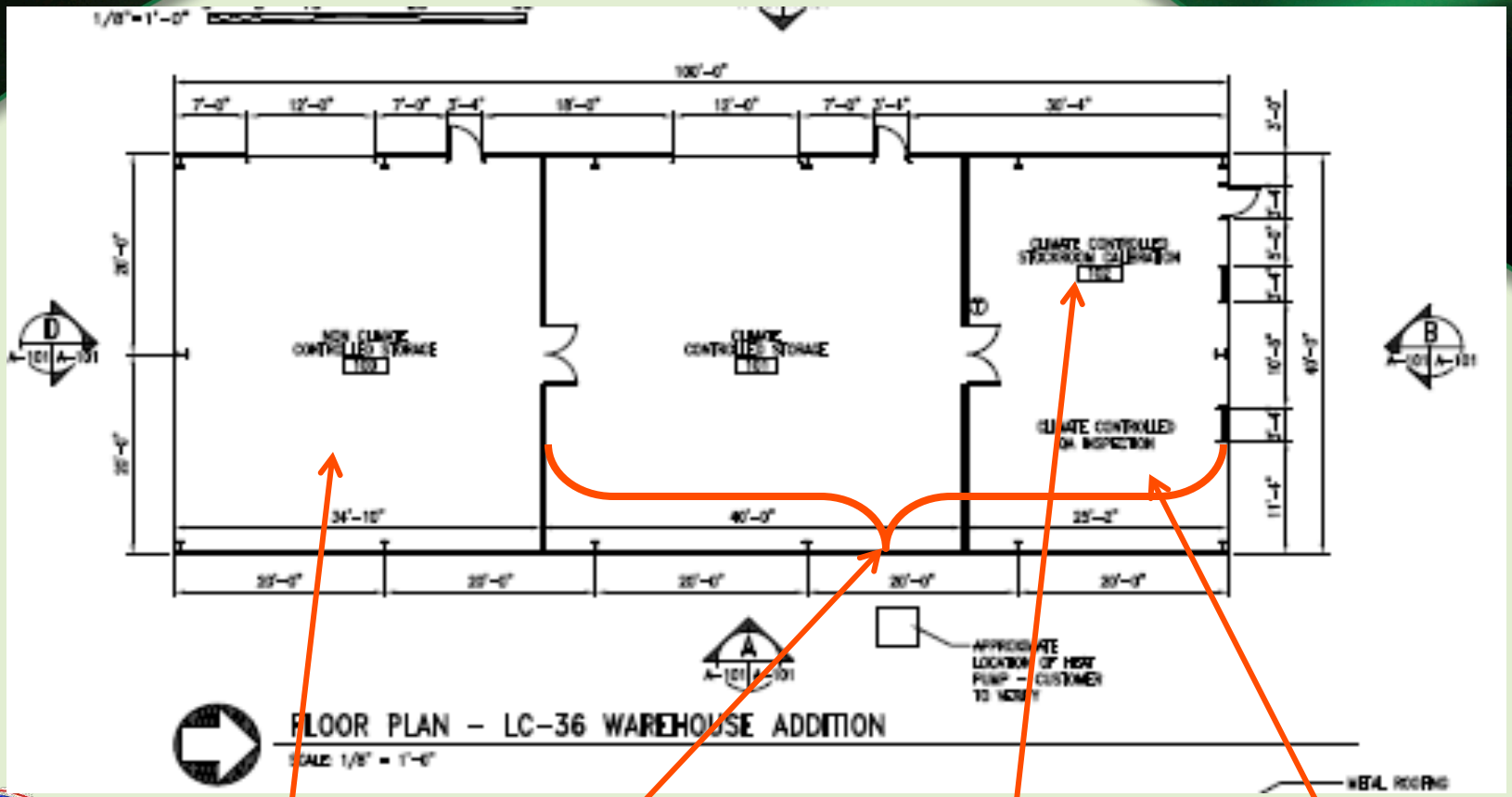
PFRR Operations Move to SOC (Finding #3)

- New addition to SOC will be required
  - Addition planned for NE side of SOC
    - Site plan exists for "garage" in this area
    - Preliminary look show this is feasible
  - Will address some of concerns of SRWG
    - Existing science ops rooms will not be impacted
    - Will provide isolation from science or direct interaction
    - Door and hallway will separate PFRCC and Science ops
  - Bandwidth addressed via range fiber upgrade
  - Light pollution issue will need to be managed
- Summer 2010 & 2011 targeted for consolidation
  - Already scheduled down time for Range (no missions)
  - Will allow for range intercom upgrade project to be completed as well

WSMR Upgrade Status

- Pre-Phase 1 construction beginning now
  - HVAC installation into low bay
  - New roll up door in low bay
    - Will have large NASA Logo facing road
  - New 40 x 100 storage building
- Projects will "help" with contamination control
  - Low bay door currently stays open all the time
- Will help begin transition of equipment from LC-35
- Projects to be completed by Sept. 30

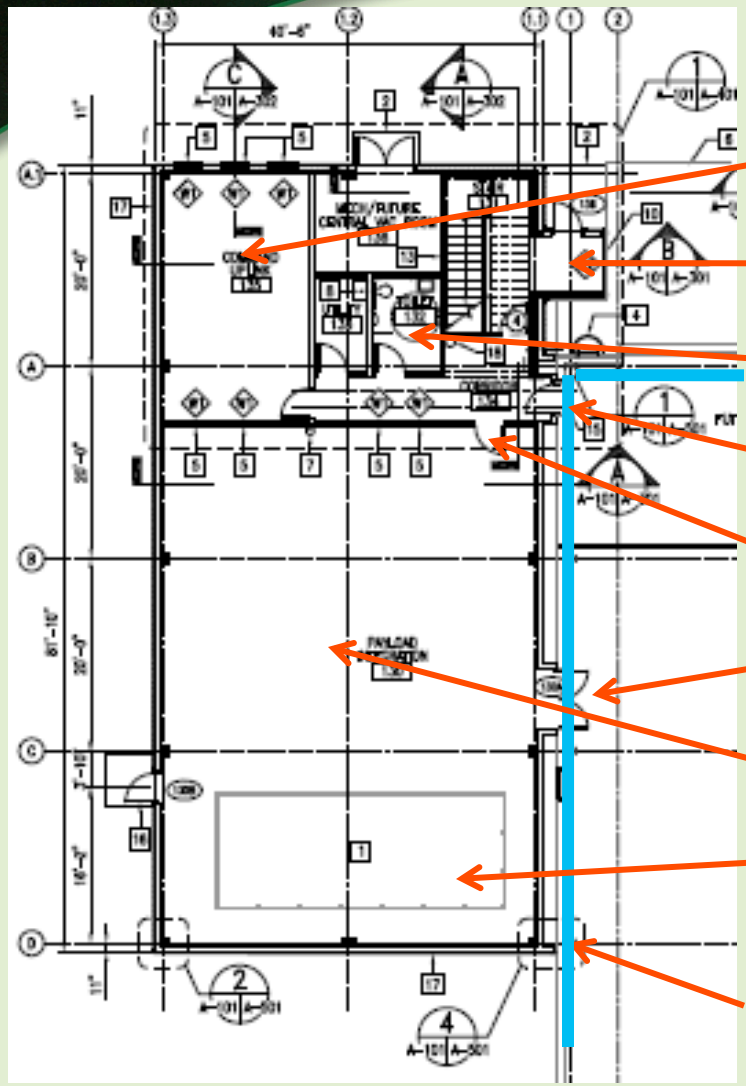
WSMR Upgrade Status
LC-36 Storage Building



WSMR Upgrade Status
Phase 1 Integration Lab

- Phase 1 Integration Lab
  - 95% drawing submitted by A&E firm last week
  - Drawings fanned out for review (including to SRWG)
  - Design review planned for this week but had to be postponed
  - Inputs received by all parties
    - incorporated as much as possible
    - could not address all issues/concerns due to limited budget and/or technical difficulties
  - Goal is to have contract awarded by end of Sept.
  - Goal for completion of construction is Summer 2010

WSMR Upgrade Status
Phase 1 Integration Lab



North

Command Uplink Room

Main Entrance (Vestibule)

Single ADA Restroom

Entrance from w/in VAB

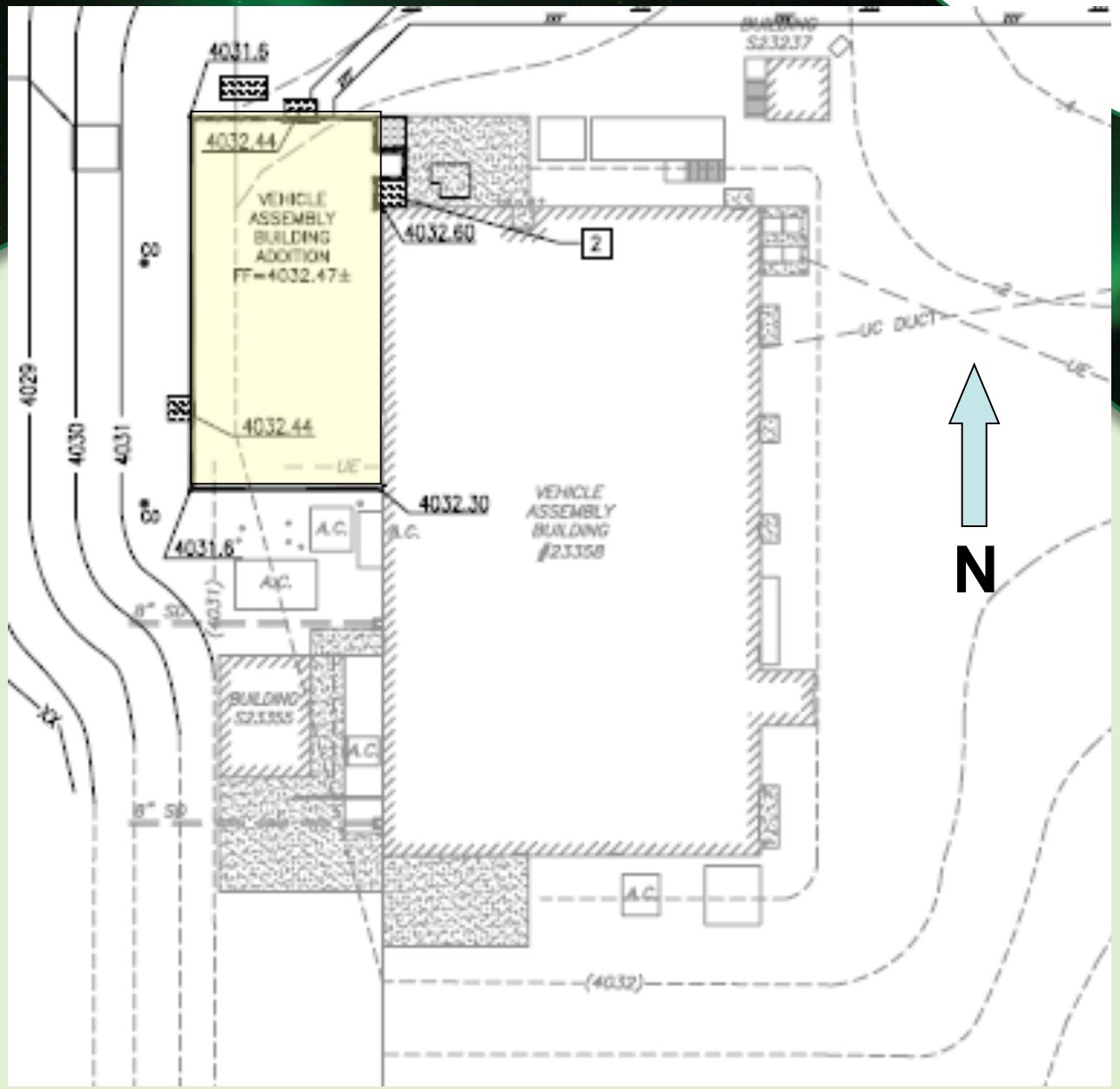
Lab Personnel Entrance (will add ante room)

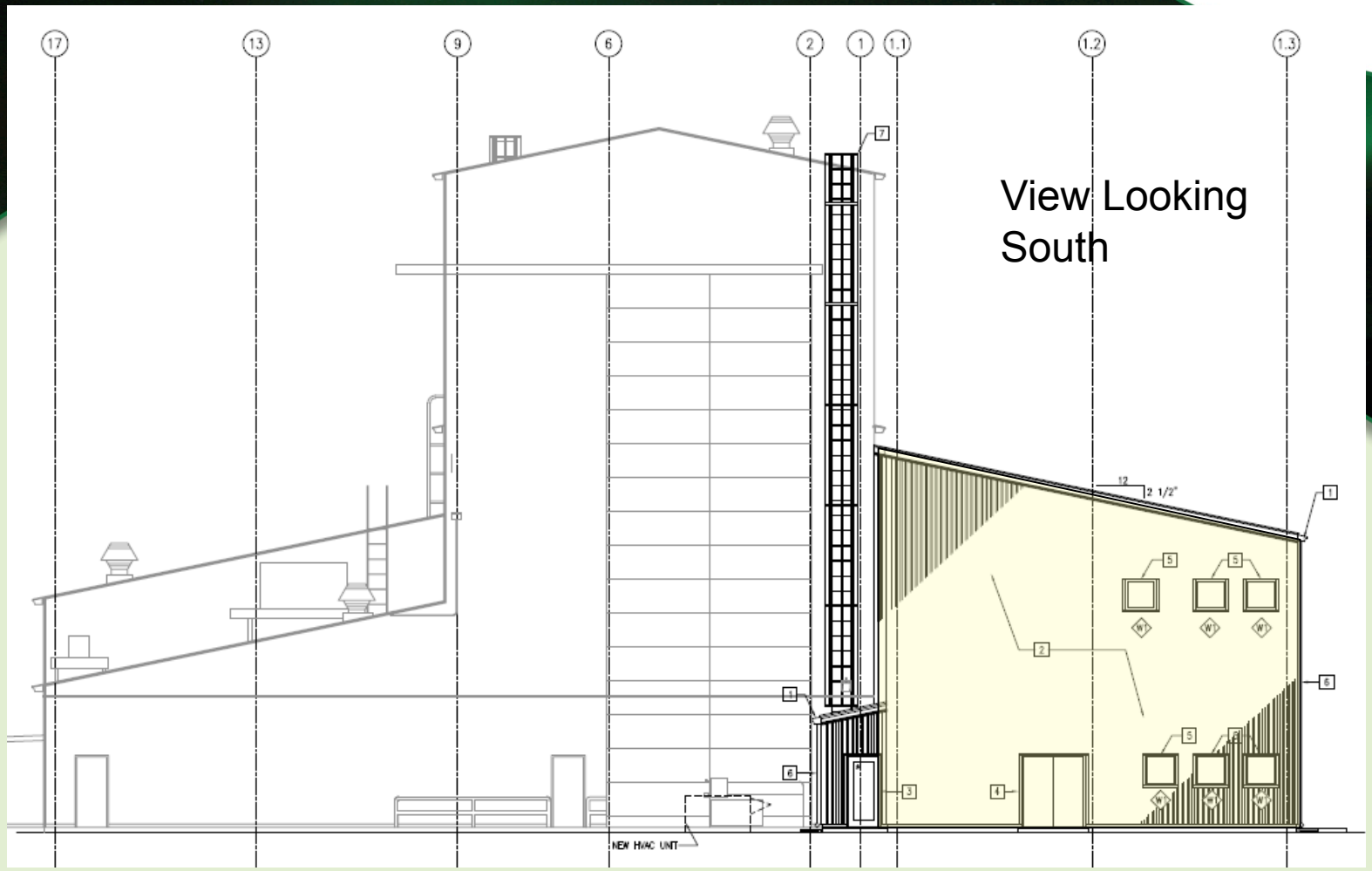
Lab “Equipment Only” Entrance

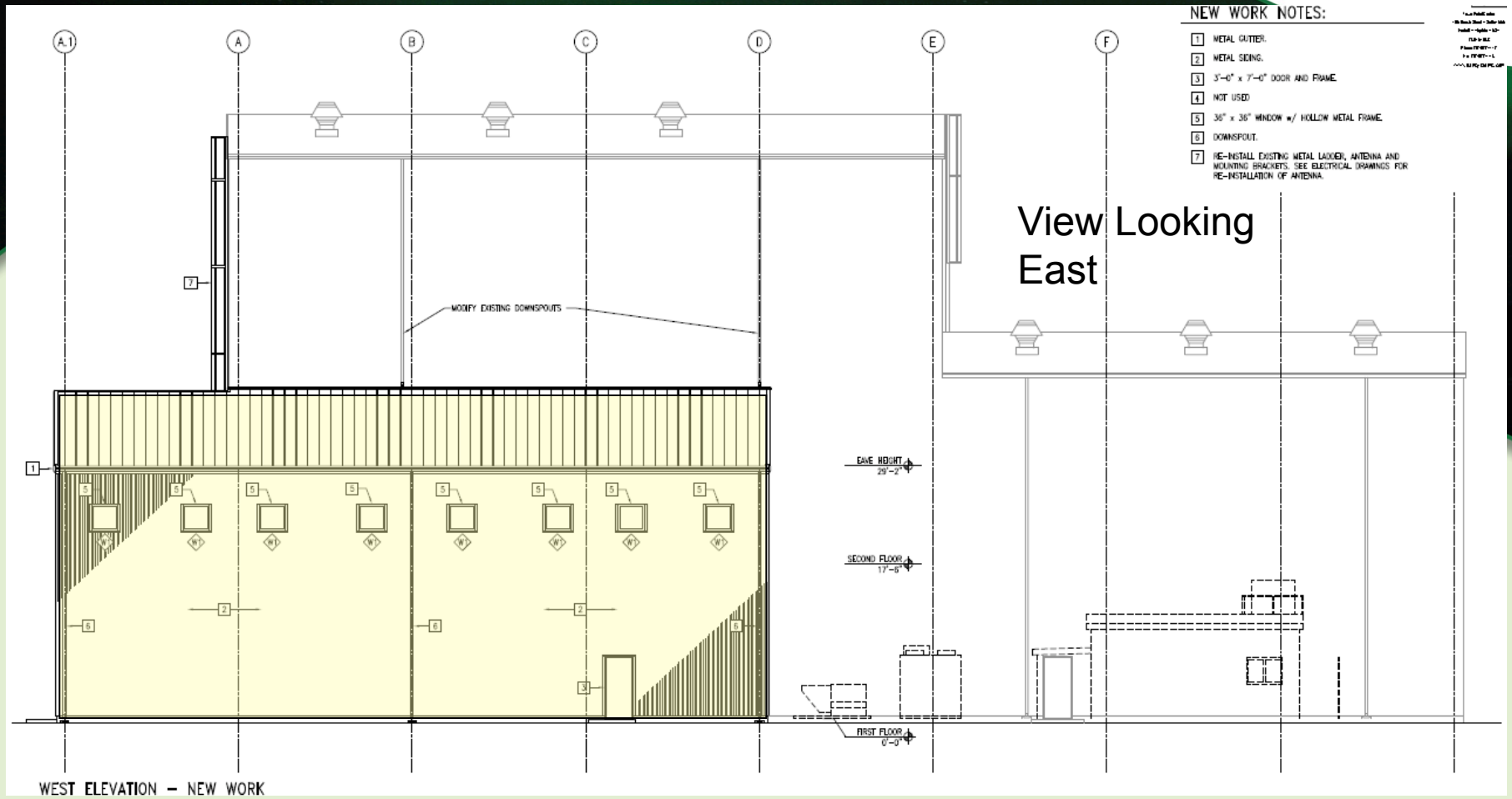
40’ x 50’ Integration Lab

Proposed Clean Tent location

Existing VAB Wall


4031.6
4032.44
VEHICLE ASSEMBLY BUILDING ADDITION FF=4032.47±
4032.60
2
4032.44
4032.30
4031.6
A.C.
VEHICLE ASSEMBLY BUILDING #23358
BUILDING 523355
BUILDING 523357
UC DUCT
UE
4029
4030
4031
(4032)
N


17
13
9
6
2
1
1.1
1.2
1.3
View Looking South
NEW HVAC UNIT



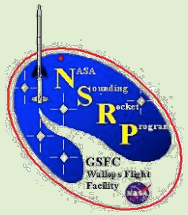
View Looking East

WSMR Upgrade Status
Phase 1 Addition

- Phase 1 Addition Key Features
  - Integration Lab
    - Positive pressure filtered ventilation system
    - Epoxy floors/walls to help with cleanliness
    - Limited entry points with ante room for main personnel entrance
    - 1 possibly 2 clean tents proposed
    - Double doors used only for equipment/payload entry and exit
    - Power/communications strip/ground bar will ring lab
  - Other Areas
    - Entrance from outside (vestibule) & from VAB high bay
    - ADA Restroom (outside lab)
    - Viewing windows from command uplink, hall, VAB high bay
    - Upstairs open to be used for office space (future)
    - Break area on second floor
    - Command uplink view of launch area

WSMR Upgrade Status
Phases 2 & 3

- Phase 2 Addition in preliminary planning stages
  - Will need to be designed to accommodate:
    - Solar laboratory
    - Pneumatics laboratory
    - Electrical tech area
    - Air bearing
    - Magnetic calibration equipment
  - Preliminary layout is only at the cartoon level
- Phase 3 VAB Rehab in preliminary planning stages
  - Ground station rehab (consolidation of LC 35 & LC 36)
  - Office space/Restroom rehab
  - VAB plant wiring rehab (power, communications, IT)
- Task is being written for NSROC to help create plans for Phase 2 and 3 upgrade projects
  - Complex effort that we must get right the first time



Rocket Motors

- Black Brant
  - Use of Firex thermal protection for fins is under development
    - Spay application to be flight tested in August 09
  - Current Order(s)
    - 17 received
    - 16 to be delivered by February 10
- Nihka
  - Redesign effort complete
    - Static verification test fire on schedule August 09
  - Order in Process
    - Nine motors to be received by February 10
- Talos
  - 20 at WFF, 6 at Indian Head, and 24 stored at Hawthorn
  - Indian Head has re-tooled for refurbishment/processing
    - First motor to be completed this week
    - 6 motors to be received from Hawthorne this month
  - 24 new boxes in process of fabrication through China Lake

Rocket Motors

- Terrier MK70
  - 73 at WFF
  - 88 tagged for NSRP though the Navy
  - 175 located at located at Hawthorn
- Improved Orion
  - 99 at WFF (27 may not be usable)
  - Working on acquisition of 100 from Red River (mid 90s vintage)
- Improved Malemute
  - 10 at WFF
  - Static fire test to be conducted in July 09
  - Working towards first NASA flight in August 09, Terrier MK70-IM
- MLRS
  - 55 at WFF
  - Two test flights conducted 08

Rocket Motors

- Procurement in Process

  Synopsis released May 09

  RFP to be released June 09

  Contract with options can procure up to 12 motors per year for up to 5 years

  Potential schedule impact if procurement complications are encountered

Technology - High Data Rate

- High Data Rate Telemetry
  - Vision of SRPO is to provide order of magnitude + leap in data rates for experimenters
  - Long time request of SRWG now appears feasible
    - Due to advancements in electronics technology
    - Lower cost components developed by other projects
    - **Availability of 11m Antennas at various locations throughout the world**

Technology - High Data Rate

- Dual approach being undertaken to provide capability for both space physics payloads as well as astrophysics and solar Long time request of SRWG now appears feasible

- Due to technical and logistical challenges different approaches will be undertaken for each
  - Space physics – direct real-time down link via X-band
  - Astro/Solar physics – on board data recording

Technology - High Data Rate

- Near term desire is to treat high data rate as comprehensive success system
  - Limited redundancy
  - Technical challenges
- Maintain heritage S-band systems for meeting minimum success

Technology - High Data Rate

- Space Physics missions overview
  - X-band down link using wrap around antenna
  - Missions normally spinning and non-recovered
  - Can be effective with or without ACS
  - Ground stations available at PFRR, Svalbard, Wallops
    - Primary locations for space physics research
    - No other ground antennas identified at this point
    - Mobile systems do not appear to be on the horizon

Technology - High Data Rate

- Space Physics missions overview
  - Retention of 11m system at Poker vital to success of this endeavor
    - System is surplus due to AGS closure
    - System has been "saved" several times
    - Currently in process of negotiating with GN to keep hardware from being given away to UAF
    - Need HQ priority to maintain system as part of Range infrastructure
      - SRPO agreed to help maintain system till X-band proof of concept demonstration

Technology - High Data Rate

- Space Physics missions overview
  - Work will be required to configure systems at Svalbard and WFF to support missions
  - Large investment being made to acquire combination receivers to support effort
    - Combination receiver, bit sync, decom, recorder units being obtained
    - $800K investment being achieved by availability of institutional capital equipment funds

Technology - High Data Rate

- Astro/Solar physics systems overview
  - On board data recording is only viable approach to obtaining high rate data
  - Interference with RF spectrum at WSMR is major issue
    - X-band – proximity to deep space network
    - Ku-band – proximity to TDRSS downlink station
    - Ka-band – proximity to LRO and SDO down link station
  - Availability of ground stations also a big problem
    - Building and installing new ground stations is not feasible $$$$

Technology - High Data Rate

- Astro/Solar physics systems overview
  - As all payloads are recovered anyway, onboard data recording is most logical approach
  - Hardware exists to do high speed data recording
    - A few systems are being evaluated at present
    - MLAS system, Space Cube, other?
  - Challenge expected in methods employed to send/buffer high and low speed data
    - Likely unique to each experiment
    - Will likely be experimenters requirement to break out and send each format
      - Difficult to "split" images outside experiment electronics
  - Further investigation required – only in feasibility stage at this point

Technology - High Data Rate

- Technology development broken into 3 phases
  - Phase I – X-band proof of concept
    - 150 Mbps being tested on piggy back experiment from Poker in 2010 (LaBelle 40.025)
    - Digitize data from single analog instrument
    - NSROC will describe in more detail
  - Phase II – X-band enhancement/data recording proof of concept
    - Possible enhancement of X-band to 200 Mbps
    - Possible encoder development
    - Proof of concept for high speed data recording
    - Targeting Sub-TEC IV mission from Wallops Summer 2010

Technology - High Data Rate

- Technology development broken into 3 phases
  - Phase III – System standardization flight qualification
    - Develop low cost producible components for standard SR systems
    - Conduct flight demonstration - 2011 time frame
- Need experimenter feedback
  - How many data channels should an encoder be capable of handling?
  - Impact of splitting high/low rate data
  - Other
- Aggressive schedule

Findings from July 2008 SRWG

Strategic Planning

- SRWG would like to participate in long range planning
- This is a good idea in general
  - The SRPO would like some focused guidance
  - Some strategic activities can not be discussed in open forums
- The SRPO Operations Manager did obtain input from the science community concerning WSMR VAB upgrades
- Sub-Committees seem like a good approach
  - Standing committees?
    - Range support and operations
    - Technology

White Sands Operations – Scheduling Issues

- SRPO recognizes this is a politically sensitive issue
  - Needs of experimenters need to be balanced with overall programmatic objectives
- Project teams need to work closely with NSROC, NASA, and Navy team members to establish realistic schedules
  - Overly optimistic schedules serve no-one
  - If 3 miracles and a bit of luck are required to meet a launch date perhaps we should consider moving to the right

White Sands Operations – Scheduling Issues

- There are no plans to create a "one size fits all" policy for scheduling
  - Each individual payload and project team needs to be evaluated separately
- It is recognized certain missions may have more schedule risk than others
  - New payloads
  - Highly complex payloads
- Milestones will be negotiated with project team to set priority launch date requests on a case by case basis

White Sands Operations – Scheduling Issues

- WSMR is a very busy range and we need to maintain our priority ranking
  - We are already on the low end of the spectrum
- We have currently been "penciling" in our requested launch date when we are uncertain we can make it
  - Gives WSMR schedule office flexibility to schedule higher priority missions with no impact
  - Maintains our credibility in schedule requests
  - Appears to be effective

Findings from July 2008 SRWG

White Sands Operations – Scheduling Issues

- Hard dates are requested in advance when time critical event is needed
  - Satellite overpass
  - Solar eclipse
- Hard dates requested when there is a high degree of confidence in meeting schedule
  - Either through milestones
  - Consolidated team consensus
- SRPO will continue to monitor situation and make adjustments as necessary

Findings from July 2008 SRWG

Proposal to shift certain Poker Flat Operations to the Science Operations Center

- Addressed as part of the Poker Range update presented earlier

Findings from July 2008 SRWG

Use of BBX, BBXI, and BBXII vehicle for astronomy and solar missions

- Range and Launcher Constraints
  - WMSR
  - WFF
  - Kwaj
  - Woomera
- Ocean Recovery
- Increased Reentry Loads

Findings from July 2008 SRWG

20 Mbit/sec TM

- PSL has an encoder (MVPCM) w/ limited decks
- Requirements need to be defined so additional decks can be developed
- 2 x 20 Mb/s should be able to be supported

- Will be discussed in detail during the afternoon session

Findings from July 2008 SRWG

NSROC Communications

- Mission Closeout Reports will be provided to PI's
- Further discussion on Mission Web Sites is needed
  - What do the science teams want to see?
  - Standard format should be developed to minimize associated work load